



2017

# MATEROVCOMPETITION

## manual

## NAVIGATOR

16th Annual

# MATE International ROV Competition

Port Cities of the Future: Commerce, Entertainment, Health, and Safety

MTS marine technology society

ROV SOCIETY

NOAA

NSF

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LONG BEACH CITY COLLEGE

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## **REVISIONS**

**Note: All revisions are highlighted in yellow within the document.**

**2/7/2017**

Part 4: Competition Rules – General – pages 32-33

# 2017 MATE ROV COMPETITION:

## *Port Cities of the Future: Commerce, Entertainment, Health, and Safety*

### NAVIGATOR CLASS COMPETITION MANUAL

For general competition information, including a description of the different competition classes, eligibility, and demonstration requirements, visit [Team Info](#).

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## OVERVIEW

### THINK OF YOURSELVES AS ENTREPRENEURS

From deepwater oil drilling to the exploration of shipwrecks and installation of instruments on the seafloor, individuals who possess entrepreneurial skills are in high demand and stand out in the crowd of potential job candidates. What are entrepreneurial skills? They include the ability to understand the breadth of business operations (e.g., finances, research and development, media outreach), work as an integral part of a team, think critically, and apply technical knowledge and skills in new and innovative ways.

To help you to better understand and develop these skills, the MATE ROV competition challenges you to think of yourself as an entrepreneur. Your first task is to create a company or organization that specializes in solutions to real-world marine technology problems. Use the following questions as a guide.

- What is your company name?
- Who are its leaders – the CEO (chief executive officer – the leader) and CFO (chief financial officer who oversees the budget and spending)?
- Who manages Government and Regulatory Affairs (i.e. who’s in charge of reviewing the competition rules and making sure that they are understood and followed by everyone)?
- Who is responsible for research and development (R&D)?
- Who is responsible for system(s) engineering? Design integration? Testing? Operations?
- Who is responsible for fund-raising, marketing, and media outreach?
- What other positions might you need? (Depending on your personnel resources, more than one person may fill more than one role.)
- What products and services do you provide?
- Who are your potential clients?

In this case, the MATE Center and the Port of Long Beach are your “clients” who recently released a request for proposals. A request for proposals (RFP) is a document that an organization posts to solicit bids from potential companies for a product or service. The specifics of your product design and rules of operation as well as the specifics of your product demonstration are included below.

## PART 1: PRODUCT DEMONSTRATION

### OVERVIEW

**NAVIGATOR** class companies will take part in ONE product demonstration that consists of four distinct tasks:

**TASK #1: COMMERCE: HYPERLOOP CONSTRUCTION**

**TASK #2: ENTERTAINMENT: LIGHT AND WATER SHOW MAINTENANCE**

**TASK #3: HEALTH: ENVIRONMENTAL CLEANUP**

## TASK #4: SAFETY: RISK MITIGATION

**NOTE:** Regional competitions may not include all 4 tasks within the product demonstration; regional competitions may also give companies more than one attempt at the product demonstration. Contact your [regional coordinator](#) to determine what will take place your regional competition. Regardless, the product demonstration score will be added to your [ENGINEERING & COMMUNICATION](#) and [SAFETY](#) scores to determine your total, overall score for the competition.

## SCORING OVERVIEW

The competition consists of product demonstrations, technical documentation, product presentations, marketing displays, and safety with the following scoring breakdown:

- **Product demonstrations)**
  - 200 points (max), plus a time bonus
  - Size restrictions
    - 10 points (max)
  - Product demonstration safety and organizational effectiveness
    - 20 points (max)
- **Engineering & Communication**
  - Technical documentation
    - 50 points (max)
  - Product presentations
    - 50 points (max)
  - Marketing displays
    - 50 points (max)
  - Company Spec Sheet
    - 10 points (max)
  - Outreach and Inspiration
    - 10 points (max)
- **Safety**
  - Safety Inspection
    - 10 points (max)

**TOTAL POINTS = 410**

**NOTE:** Regional contests may not require the JSAs or all of the Engineering & Communication components. Contact your [regional coordinator](#) for more information.

## TIME

Each product demonstration includes:

- 5 minutes to set up at the product demonstration station

- 15 minutes to attempt the tasks
- 5 minutes to break down and exit the product demonstration station

Your company will have 5 minutes to set up your system, 15 minutes to complete the tasks, and 5 minutes to demobilize your equipment and exit the product demonstration station. During the 5-minute set-up, you may reassemble your vehicle after the size determination and weigh-in and place it in the water for testing and/or trimming purposes. The 15-minute demonstration period will begin after the full 5 minutes of set up time expires, regardless of whether the company is ready to start the product demonstration. It may begin sooner if your CEO notifies the product demonstration station judges that your company is ready to begin.

At any time during the demonstration, you may pilot your ROV to the surface and remove the vehicle from the water for such things as buoyancy adjustments, payload changes, and troubleshooting, but the 15-minute product demonstration clock will only be stopped by a judge who determines it is necessary for reasons beyond your control. Otherwise, the clock will only stop after all of the tasks are successfully completed, the ROV has returned to the surface under its own power so that it touches the side of the pool, and a company member at the product demonstration station has physically touched the vehicle. Your ROV is not required to return to the surface between tasks.

Your 5-minute demobilization will begin as soon as the 15-minute demonstration time ends, regardless of where your ROV is located (i.e., still at depth, on the surface, etc.).

Regional competitions may alter the set-up, product demonstration time, or demobilization time. Contact your [regional coordinator](#) to verify the timing of your product demonstrations.

### **TIME BONUS**

Companies will receive a time bonus for each product demonstration if you:

- 1) successfully complete all the tasks,
- 2) return your ROV to the surface under its own power so that it touches the side of the pool, and
- 3) physically touch your vehicle before the demonstration time ends.

Companies will receive 1 point for every minute and 0.01 point for every second under 15 minutes remaining.

### **CONTEXT**

The Port of Long Beach is one of the world's busiest seaports. It is the second-busiest container port in the United States, after the Port of Los Angeles, which it connects to. It acts as a major gateway for trade between the United States and Asia. The port occupies 13 km<sup>2</sup> of land with 40 km of waterfront in the city of Long Beach, California. The Port of Long Beach is located less than 3 km southwest of downtown Long Beach and approximately 40 km south of downtown Los Angeles.

The port has 10 piers, 80 ship berths, 66 gantry cranes, and 22 shipping terminals. More than 2,000 vessels dock at the Port of Long Beach each year, moving \$180 billion in cargo. Each year, it handles more than 6.8

million 20-foot containers; it is possible for the port to handle up to 30,000 cargo containers in one day. In U.S. dollars, the seaport generates nearly \$100 billion in trade each year. It provides more than 316,000 jobs in Southern California; 1.4 million jobs throughout the U.S. are related to trade generated by Long Beach.

In addition to **commerce**, the port includes cruise ships and activities related to tourism and **entertainment**.

Docked in Long Beach Harbor is the RMS (Royal Mail Ship) Queen Mary, a colossal ship bigger, faster, and more powerful than the RMS Titanic. Built in Scotland, the 1,000-foot ship made her maiden voyage on May 27, 1936. After three years of hosting the world's rich and famous across the Atlantic, she was called into service during World War II. She became known as "The Grey Ghost," carrying more than 800,000 troops, traveling more than 600,000 miles, and playing an important role in virtually every major campaign, including the D-Day invasion. In 1967, she was withdrawn from service after more than 1,000 transatlantic crossings. That same year, the Queen Mary was sold for \$3.45 million to the City of Long Beach for use as a maritime museum and hotel.

With all of the activity and vessel traffic, accidents and pollution are bound to happen. For example, thousands of dollars have been spent on the clean-up of contaminated sites, such as the IR Site 7 dredging project to remove chemicals that entered the harbor from the former Long Beach Naval Station. More than 400,000m<sup>2</sup> of contaminated sediments were removed during that project. In addition, each year thousands of containers fall off of cargo ships, sometimes in harbors as ships are entering or leaving port.

The Port of Long Beach is governed by the City of Long Beach, which created the Long Beach Harbor Department to promote and develop the Port. The Harbor Department's primary responsibility is the **health** and **safety** of the port and waterfront.

## **NEED**

The Port of Long Beach has issued a request for proposals (RFP) for a remotely operated vehicle and crew that can operate in the sometimes confined and often precarious conditions of the port and waterfront. Specifically, the port managers are in need of an ROV that can 1) assist with the installation of a Hyperloop system to expedite the delivery of goods and streamline **commerce**; 2) conduct maintenance on the port's water and light show to guarantee uninterrupted **entertainment**; 3) identify and collect samples of contaminated sediment then remediate the area to protect the **health** of people and the environment; and 4) identify the contents of containers that fell off of a cargo ship into the harbor and map the accident site to ensure the **safety** of the port and its operations.

Before launch and operations, the ROV must complete a series of "product demonstrations" staged in the swimming pool on the campus of Long Beach City College and at various regional locations. (Depth requirements vary depending on competition class; see [VEHICLE DESIGN & BUILDING SPECIFICATIONS](#) below.) Companies that successfully complete the product demonstrations and deliver exceptional engineering and communication components (e.g. technical documentation, product presentations, and marketing displays) will be awarded the contract.



## This is where your work begins.

Visit [www.youtube.com/watch?v=Tn-jUbpFV4A](http://www.youtube.com/watch?v=Tn-jUbpFV4A) for sound advice from MATE judge Marty Klein. He references 2015, but his words hold true for any competition season!

## REQUEST FOR PROPOSALS (RFP)

### 1. General

#### a. Commerce: Hyperloop Construction

The Port of Long Beach is starting on one of the largest, most expensive, and possibly most significant projects in the history of shipping ports. The port is starting construction of the first-ever underwater hyperloop system designed to transport cargo. The system will allow ships to drop freight into massive underwater hyperloop tunnels miles offshore, delivering their goods without ever coming into port.

For shipping companies, it will make delivery of goods much more efficient. Cargo ships sometimes wait in line for days to reach port; the new system will stretch out far enough to provide as many docking points as needed. Because it will be so much faster, it will help to save money and, in doing so, should make goods cheaper.

It could also dramatically reduce pollution. Combined, the Ports of Los Angeles and Long Beach are the largest complex in the country. While ships wait in line, they typically spew smog into nearby neighborhoods; children in Long Beach also have the highest rates of asthma. Keeping ships farther offshore would help. Moving ports offshore would also free up beautiful coastline areas for parks and beaches rather than acres of cranes.



Concept drawing of an underwater hyperloop system. <http://inhabitat.com/hyperloop-one-plans-to-take-supersonic-transportation-underwater/>

A survey of the seafloor has been completed and beacons to help with navigation and positioning of the underwater structure have been placed at selected locations. With these tasks completed,

the construction phase is ready to begin.

**b. Entertainment: Light and Water Show Maintenance**

The Port of Long Beach has invested time and money to attract tourists and other visitors – along with their wallets – to the waterfront. In addition to the RMS Queen Mary, the harbor includes tours of the Russian Scorpion submarine, creatures of the deep at the Aquarium of the Pacific, and the newest attraction, a water and light show.

With its kaleidoscope of colors, fanciful music, and more than 1,000 fountains shooting water 100 feet into the air, the port's water and light show, *a-MATE-zing*, is a spectacular blend of art and technology. It is also a hugely popular nighttime attraction, which makes maintaining it to avoid downtime and ensure uninterrupted operation a priority.

The show is due for routine maintenance. Specifically, one of the water fountains needs to be removed and replaced. The fountain is located in the center of the show's primary platform.



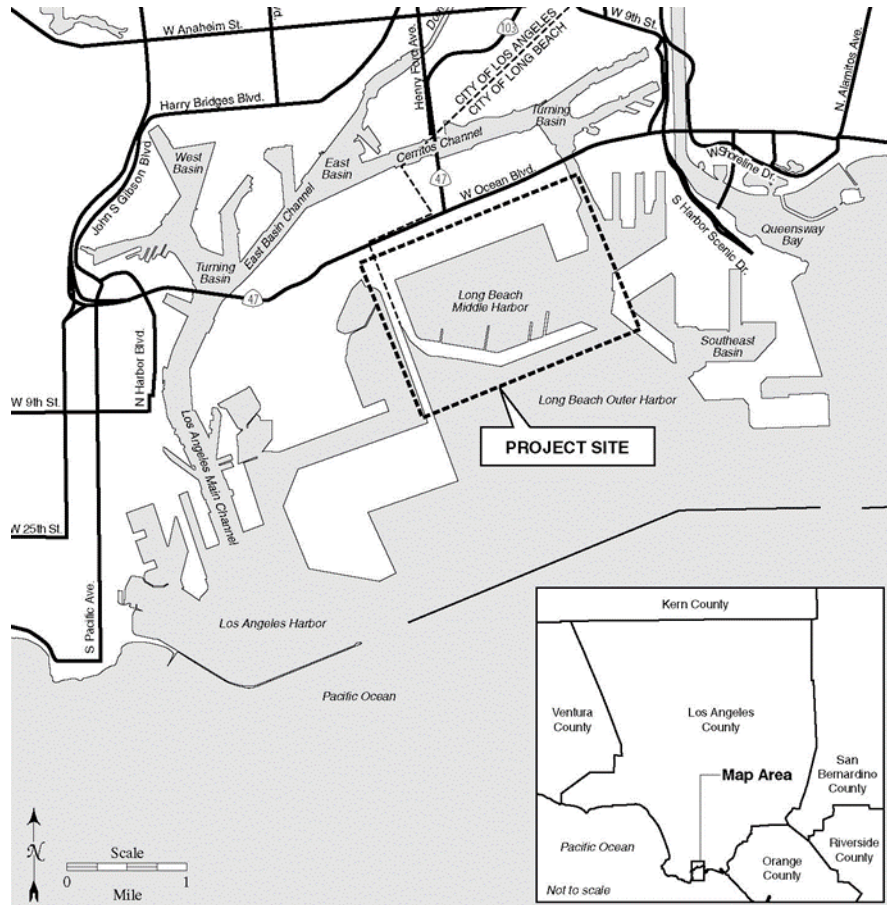
A colorful water and light show. <http://42ndclass.com/wp-content/uploads/2014/08/lima-water-show-fountains-12.jpg>

**c. Health: Environmental Cleanup**

As a result of over 50 years of shipping and industrial uses by the U.S. Navy's Long Beach operations, high concentrations heavy metals (copper, lead, mercury, silver and zinc), DDT, and PCBs were measured in sediments collected from the Installation Restoration (IR) Site 7 area in the Port of Long Beach. Because of the potential risks to benthic organisms, the port and its partners – Base Realignment and Closure (BRAC) Clean-up Team, U.S. Fish and Wildlife Service, California Department of Fish and Game, National Marine Fisheries Service, Restoration Advisory

Board, and the Army Corps of Engineers – launched an environmental clean-up project to remove contaminated sediments from the area.

Clean-up focused on dredging and removing the harmful sediments. Once removed, the sediments were taken to the Pier G fill site, which was designed to effectively contain contaminated sediment and control water runoff as the sediments settle.



IR Site 7 remediation project site.

<http://www.polb.com/civica/filebank/blobload.asp?BlobID=5360>

However, nearly eight years later, there is some concern that contaminants still remain. To address these concerns, the port and its partners have started a follow-up project that involves additional sampling and analysis of sediments as well as benthic organisms.

For efficiency – and to make the best use of time and money – before collecting sediment samples, the project will use Raman spectroscopy to determine if the sediments are still contaminated. Raman spectroscopy is commonly used in chemistry to determine the chemical composition of an object or substance. It can identify and count the molecules and produce a chemical “fingerprint” of that object or substance. The advantages of using Raman spectroscopy

for this project is that it can be done “in situ” and without having to collect a sample and bring it to the surface for analysis.

Put simply, Raman spectroscopy involves focusing a very bright one-color light source (i.e., laser) on an object or substance and detecting a specific type of scattered light energy called Raman. The chemical fingerprint, also known as a spectrum, is produced when the scattered Raman light passes into a detector where it is broken into wavelengths and plotted. (For more specific information about Raman spectroscopy, see REFERENCES below.)

If high levels of contaminants are found, this time the clean-up technique will involve capping, rather than dredging, the contaminated area. A layer of gravel, rock, and sand will be placed on the top of contaminated area to cover the sediment and keep the contaminants from harming marine life.

**d. Safety: Risk Mitigation**

The Port of Long Beach handles 82.3 million metric tons of cargo each year. The ability to monitor and track these containers while at sea and in port is extremely important to the safety and security of the port, its operations, and its people.

The Port of Long Beach began a pilot program of tracking containers using active Radio Frequency Identification or RFID technology. Cargo containers are outfitted with RFID tags, which are transponders that hold information on a microchip. A reader or “interrogator” activates the transponder using radio waves. Once activated, the transponder transfers its information to the reader. Because radio waves do not travel well through salt water, the transponder and reader must be close to each other to communicate.

A boater moving reported seeing cargo containers fall off of a freighter as it was leaving the port during the night. The boater was unable to identify the ship, but did provide a GPS estimate of where the ship was located when the containers fell. That location is approximately 750 meters south of the West End Long Beach Breakwater opening and at the edge of heavy traffic lanes. The boater also provided a dark, grainy cellphone photo of the containers sinking into the water.

Port security and the U.S. Coast Guard have been called in to investigate. Given vessel traffic and the supposed location of the incident, the idea of deploying SCUBA divers is out of the question. They need help finding the cargo containers, determining their contents, and marking those with hazardous cargo.

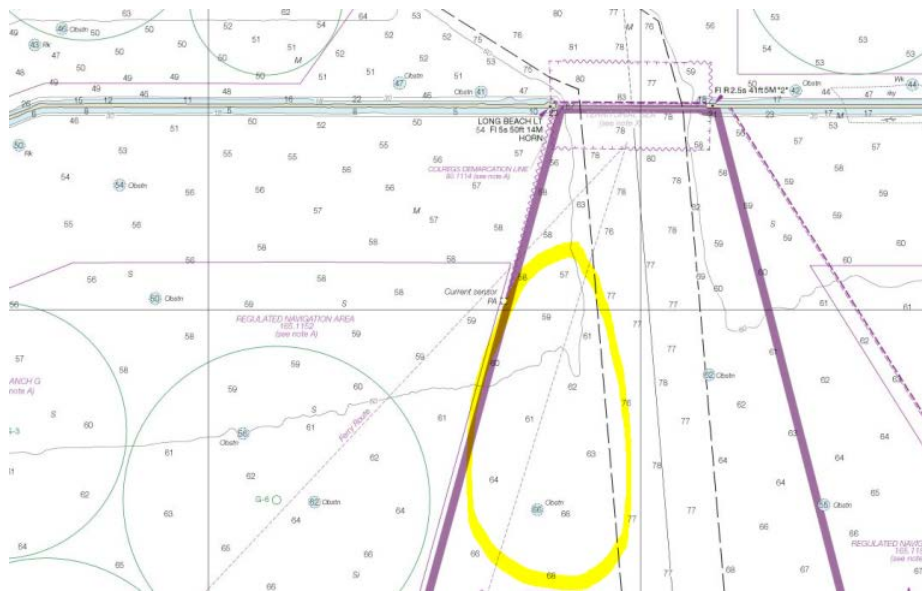


Chart of waters around the West End Long Beach Breakwater opening.

[www.charts.noaa.gov/OnLineViewer/18751/shtml](http://www.charts.noaa.gov/OnLineViewer/18751/shtml)

**e. Document Scope and Purpose**

This and the following sections contain the technical specifications and requirements for ROV services needed to support the Port of Long Beach. In 2017, ROV services include:

**1) COMMERCE: HYPERLOOP CONSTRUCTION**

- Inserting one rebar reinforcement rod into position in the steel baseplate.
- Installing the frame onto the baseplate.
- Removing a pin to release the chains holding the frame.
- Transporting and positioning the hose for pouring concrete into the frame.
- Retrieving the three positioning beacons and returning them to the surface.

**2) ENTERTAINMENT: LIGHT AND WATER SHOW MAINTENANCE**

- Disconnecting the power cable from the platform.
- Turning the valve to stop the flow of water to the platform.
- Removing the old fountain.
- Installing the new fountain.
- Turning the valve to restore the flow of water to the platform.
- Reconnecting the power cable to the platform.
- Returning the old fountain to the surface, side of the pool.

**3) HEALTH: ENVIRONMENTAL CLEANUP**

- Collecting a sediment sample and returning it to the surface.
- Collecting two clams from the contaminated area and returning them to the surface.
- Placing a cap over the contaminated sediments.

#### 4) SAFETY: RISK MITIGATION

- Locating the two cargo containers.
- Inserting the sensor provided by MATE into the port on the side of each container to activate the RFID. The RFID will be simulated by LED lights on the surface at the side of the pool.
- Using the data to determine the container's identification number, contents, and if the contents are high risk.
- Attaching a buoy marker to the U-bolt on the container with high-risk cargo.

## 2. Specifications

See the specific tasks described below as well as the [VEHICLE DESIGN & BUILDING SPECIFICATIONS](#) and [COMPETITION RULES](#) sections.

## 3. Maintenance and Technical Support

The company shall warrant the ROV and associated systems and equipment for at least the duration of the product demonstrations. Repair or replacement shall be at the company's expense, including the cost of shipping the ROV to and from the competition facility.

During regional events, the company shall provide at least one day of technical support to resolve hardware, software, and operational issues. They shall provide at least three days of the same for the international event.

## 4. Shipping and Storage

Delivery of the ROV and associated systems and equipment shall be no later than the date of the geographically closest regional contest.

## 5. Evaluation Criteria

- a. Technical documentation
- b. Product presentation
- c. Marketing display
- d. Product demonstration

## 6. References

### a. GENERAL

- i. [www.polb.com/about/facts.asp](http://www.polb.com/about/facts.asp)
- ii. [https://en.wikipedia.org/wiki/Port\\_of\\_Long\\_Beach](https://en.wikipedia.org/wiki/Port_of_Long_Beach)
- iii. [www.legendsofamerica.com/ca-queenmary.html](http://www.legendsofamerica.com/ca-queenmary.html)
- iv. <http://ascelibrary.org/doi/abs/10.1061/9780784413067.019>

### b. COMMERCE

- i. <https://hyperloop-one.com/what-is-hyperloop>
- ii. <https://www.fastcoexist.com/3062709/imagine-a-hyperloop-that-uses-underwater-tunnels-to-replace-cargo-ships>



c. ENTERTAINMENT

- i. <https://disneyland.disney.go.com/entertainment/disney-california-adventure/world-of-color/>

d. HEALTH

- i. <http://polb.com/civica/filebank/blobdload.asp?BlobID=6613>
- ii. <http://www.polb.com/civica/filebank/blobdload.asp?BlobID=5360>
- iii. <http://slideplayer.com/slide/4649071/>
- iv. <https://clu-in.org/contaminantfocus/default.focus/sec/Sediments/cat/Remediation/p/2>
- v. <http://www.inphotonics.com/raman.htm>
- vi. <http://www3.mbari.org/news/homepage/2004/laser-raman.html>
- vii. <http://www3.mbari.org/news/homepage/2004/laser-raman.html>
- viii. <http://www.cpeo.org/techtree/ttdescript/sedcap.htm>

e. SAFETY

- i. <http://losangeles.cbslocal.com/2015/06/02/5-cargo-containers-fall-into-water-at-port-of-la/>
- ii. <http://www.rfidjournal.com/articles/view?1965>
- iii. <http://www.rfidjournal.com/articles/view?3870>
- iv. <https://www.case.edu/does/ChemSafety/shipHazMat.html>
- v. <http://www.winmec.ucla.edu/rfid/course/2007f/Container%20Tracking%20with%20RFID%20and%20Port%20Security.pdf>

**IMPORTANT NOTE: Questions about production demonstrations and design and building specifications must be posted to the competition FAQs board located at [www.marinetech.org/forums/](http://www.marinetech.org/forums/). This allows all companies to see the questions and answers and helps to avoid duplicate questions. That said, please make sure that your question(s) has not already been asked – and answered – before posting. It is up to the companies to read, comprehend, and comply with ALL rulings posted on the FAQ board.**

## SIZE AND WEIGHT RESTRICTIONS

The Port of Long Beach has included an ROV size and weight requirement in the request for proposals (RFP). Smaller, lighter vehicles will be given special consideration and vehicles above a certain size and weight will not be considered.

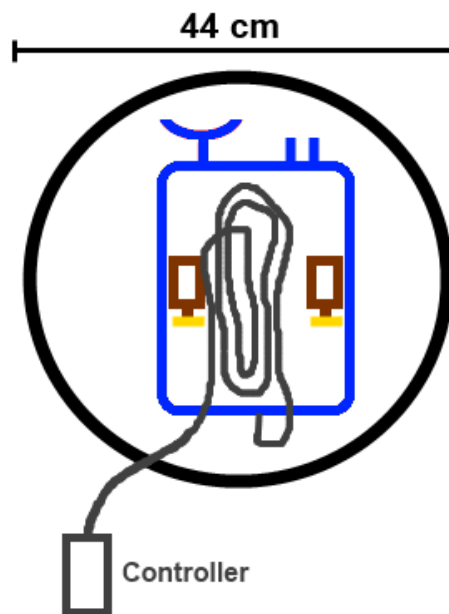
Vehicles will be measured in the NAVIGATOR on-deck circle 30 minutes prior to the company's product demonstration runs. Note that the vehicle will be measured before all product demonstration runs. The size bonus, if any, will be added into the product demonstration score.

### Size Measurements

Size measurements will be made using the two largest dimensions of the ROV. Two rings with diameters of 44 cm and 54 cm will be located on a table in the on deck circle. Companies will place their vehicles on the

measuring table and, when ready, ask a MATE Center judge to make the size measurement. The vehicle measurement must include the vehicle, all manipulators/tools to be used in the product demonstration, and the vehicle's tether. The control system and 1 meter of tether may be outside of the measurement circle. Companies must present their completely assembled ROV for measurement; companies may NOT detach manipulator arms or other equipment for the measurement.

The ring must fit over the two largest dimensions of the ROV. If the ROV and all its equipment fit within the ring of 44 cm in diameter, the company will receive +10 bonus points. If the ROV and all its equipment fit within the ring of 54 cm in diameter, the company will receive +5 bonus points. If the ROV and all its equipment does not fit within the ring of 54 cm in diameter, the company will receive no bonus points, but can still compete in the product demonstration.



*A NAVIGATOR class vehicle, with tools attached and tether coiled on top, inside the 44 cm diameter circle. This vehicle would earn the company +10 bonus points on the product demonstration score.*

Only the four designated product demonstration team members will be allowed into the on-deck circle during and after the measurement and weigh in. Once a company's vehicle has been measured, no new equipment (equipment that was not included in the size measurements) may be added to the vehicle. If it is discovered that a company added equipment that was not included in the measurements, that company will not be permitted to compete in that product demonstration run.

Videos showing simulated size measurements will be posted [here](#) by December 9, 2016.



## PRODUCT DEMONSTRATION

### TASK 1: COMMERCE: HYPERLOOP CONSTRUCTION

Your company is tasked with inserting a rebar reinforcement rod into the center of a steel baseplate that has already been placed on the seafloor. Your ROV will then serve as the “eyes” for you and your teammates as you lower the frame for the concrete onto the baseplate; your ROV will need to assist with the placement of the frame. Once in place, your ROV must remove a pin to release the chains that are holding the frame from the surface. Then your ROV must transport and position the hose for pouring concrete into the center of the frame. Finally, you must retrieve the positioning beacons and return them to the surface.

**This task involves the following steps:**

- **Inserting one rebar reinforcement rod into position in the steel baseplate – 10 points**
- **Installing the frame onto the baseplate – 20 points**
- **Removing a pin to release the chains holding the frame – 5 points**
- **Transporting and positioning the hose for pouring concrete into the frame – 10 points**
- **Retrieving the three positioning beacons and returning them to the surface – 5 points each (15 points total)**

**TOTAL POINTS = 60**

#### **Product Demonstration Notes:**

Companies must complete the steps of Task 1: Commerce: Hyperloop Construction in order. Companies may not skip a step of this task. Companies may alternate between the steps of the Commerce: Hyperloop Construction task and the other product demonstration tasks.

Companies must insert one rebar reinforcement rod into position in the steel baseplate. The steel baseplate will be constructed out of ½-inch PVC pipe. The rebar reinforcement rod must be inserted into 1 ½-inch PVC pipe sockets located in the center of the baseplate. The rebar will be simulated by lengths of ½-inch PVC pipe with a tee on top. Two simulated rebar rods will be located on an elevator platform within 1 meter of the steel baseplate. Either of the two rods can be inserted into position. Companies will receive 10 points for successfully inserting the simulated rebar rod into position on the steel baseplate. A successful insertion is the rod no longer in contact with the ROV and within the 1 ½-inch PVC pipe.

Once the rebar rod is successfully positioned, companies must install the frame onto the baseplate. A length of ½-inch PVC pipe will extend 12 cm upwards at each corner of the square baseplate. The frame will be constructed from 2-inch pipe, with a pair of 2-inch tees at each corner. Lengths of #100 chain will be attached to each corner of the frame. These lengths will connect to a 1-inch PVC coupling and a rope leading to the surface. When lowered from the surface, the openings of these 2-inch tees will fit over the ½-inch lengths of pipe in each corner of the baseplate. A company member on the side of the pool will act as a crane operator, raising, lowering, and manipulating the frame to fit over the baseplate. The ROV must supervise this process, and is permitted to assist the crane operators on the surface. The pilot may instruct the crane operator on

which direction to move or twist the ropes holding the frame and whether to raise or lower the frame. The ROV may bump the frame to move it, but the ROV is not allowed to grab and move the frame itself. Companies will receive 20 points when the frame is successfully installed on the baseplate.

When the frame is successfully installed, companies must pull a pin to release the chains attached to each corner of the frame. The pin will be constructed from a galvanized steel tent peg. It will be pushed through one hole in the 1-inch PVC coupling, through the links of the four chains attached to each corner of the frame, and out through a second hold in the 1-inch PVC coupling. Companies will receive 5 points when they successfully pull the pin from coupling. Successfully pulling the pin is defined as the pin no longer in contact with PVC coupling. Companies may return the pin to the surface or place it on the pool bottom. When the chains have been released from the frame, the rope and remaining chains can be returned to the surface.

The frame will weigh less than 20 Newtons in water.

After pulling the pin and releasing the chains attached to the frame, companies must position the hose for pouring concrete inside the frame. The hose will be constructed from garden hose with a 1-inch PVC cross at the end. A #310 U-bolt will be attached to the cross and will serve as a grab point. The hose will be pre-positioned on the bottom, within 1 meter of the baseplate. Companies will receive 10 points when they successfully position the end of the hose inside the frame. A successful positioning is defined as the 1-inch cross no longer in contact with the ROV and inside the 2-inch PVC of the frame. The hose must stay in position for 10 seconds after the ROV releases it.

The final step of this task is to retrieve the three positioning beacons located around the construction site and return them to the surface. The positioning beacons will be constructed from 1 ¼-inch PVC couplings. Two Velcro strips will be attached to the outside of the coupling. Companies will receive 5 points each, 15 points total, when they return the positioning beacons to the surface, side of the pool.

The positioning beacons will weigh less than 5 Newtons in water.

## **TASK 2: ENTERTAINMENT: LIGHT AND WATER SHOW MAINTENANCE**

Your company is tasked with piloting your ROV to the platform to disconnect the power cable and turn a valve to stop the flow of water. Then you must pilot your ROV to the topside of the platform to remove the old fountain and install a new fountain. After installing a new fountain, you must reconnect power cable and turn the valve to restore the flow of water. You must also return the old fountain to the surface.

**This task involves the following steps:**

- **Disconnecting the power cable from the platform – 5 points**
- **Turning the valve to stop the flow of water to the platform – 10 points**
- **Removing the old fountain – 5 points**
- **Installing the new fountain – 5 points**

- **Turning the valve to restore the flow of water to the platform – 10 points**
- **Reconnecting the power cable to the platform – 10 points**
- **Returning the old fountain to the surface, side of the pool – 5 points**

**TOTAL POINTS = 50**

**Product Demonstration Notes:**

Companies must first disconnect the power cable and turn the valve to stop the flow of water. These two steps may be done in any order, but must be completed before continuing to the other steps of this task. Companies must remove the old fountain and install the new fountain. These two steps must be done in order. After installing the new fountain, companies must turn the valve to restore the flow of water and reconnect the power cable. These two steps may be done in any order. Companies must also return the old fountain to the surface. Returning the old fountain to the surface may be done at any time after removing it from the platform. Companies may alternate between the steps of the Entertainment: Light and Water Show Maintenance task and the other product demonstration tasks.

The entertainment platform will be constructed out of a PVC frame with corrugated plastic attached to the top. The framework will rest on the bottom of the pool. The platform is approximately 1 square meter in length and width, and 0.4 meters tall.

Companies must disconnect the power cable from the platform and turn the valve to stop the flow of water to the platform. The power cable will be located on the outside, bottom corner of the platform frame. The valve will be located on the outside perimeter of the platform frame as well. These two steps can be done in either order.

The power cable connector will be constructed of 1-inch PVC pipe and a 1-inch PVC cross. A 2 meter length of 18-gauge red/black power wire will be attached to the connector. Both a screw hook and a screw eye will act as grab points on the cable connector, but companies may move the power cable connector by any method they wish. The port for the connector will be constructed from 2-inch PVC pipe. The port will be positioned horizontally, i.e., it will be parallel to the bottom of the pool. At the start of the product demonstration, the cable connector will be inserted into the port. Companies must disconnect the power cable from the platform by pulling the connector out of the port. Companies will receive 5 points when the cable connector is no longer touching the 2-inch PVC of the port. Companies may leave the power cable connector anywhere (e.g. on the pool bottom, in a collection basket on the ROV) they wish once it is successfully disconnected.

The valve will be constructed of a ½-inch gate valve and will be built into the ½-PVC framework of the platform. A ½-inch PVC cross will be attached to the gate valve and four 20 cm lengths of PVC will be inserted into the cross. The valve will be positioned vertically (perpendicular to the pool bottom) and located approximately 25 cm above the bottom of the pool. Companies will receive 10 points when they turn the valve to stop the flow of water. Companies must turn the valve clockwise 360°, approximately 1 time around, to successfully stop the flow of water. One 20 cm length of PVC pipe attached to the valve will be painted red to verify the amount of rotation of the valve. No actual water will be running through the valve or pipes.

Companies must then remove the old fountain and install the new fountain. At the start of the product demonstration, the old fountain will be located on the top of the platform, resting over a 1-inch end cap on the corrugated plastic sheet. The new fountain will be located at the surface, side of the pool and can be attached to the vehicle during the set up period. Both fountains will be constructed from a 3-inch to 2-inch ABS reducer bushing with two 1/2-inch end caps attached to the top. A length of rope will serve as a grab point for the fountains. Companies will get 5 points for removing the old fountain. Removing the old fountain is defined as the old fountain no longer in contact with the 1-inch PVC end cap that it rests on. Companies will get 5 points when they install the new fountain. Installing the new fountain is defined as the fountain no longer in contact with the ROV, resting over the 1-inch PVC end cap and flush with the corrugated plastic topside of the platform. The new fountain must be transported by the ROV.

Fountains will weigh less than 10 Newtons in water.

Once the new fountain is installed, companies must reconnect the power cable to the platform and turn the valve to restore the flow of water to the platform. These two steps can be done in either order.

Companies must retrieve the power cable connector, and insert it into the 2-inch PVC port. Companies will receive 10 points when they successfully insert the power cable connector into the port. A successful installation is defined as the 1-inch cross on the cable connector positioned in, or flush against, the 2-inch pipe of the port. The cable connector must stay inside the port until all steps of this task are complete. If this is the final step of the task, the connector must stay inside the port for 5 seconds after being released by the vehicle to count as a successful insertion.

Companies must turn the valve to restore the flow of water to the platform. The valve must be turned counter-clockwise 360°, approximately 1 time around, to restore the flow of water to the platform. Companies will receive 10 points when they successfully turn the valve handle 1 turn counter-clockwise.

Companies must return the old fountain to the surface, side of the pool. This step may be done at any time after the old fountain is removed from the platform. Companies will receive 5 points when the old fountain is returned to the surface, side of the pool. If returning the old fountain to the surface is the final task of the product demonstration period, time will stop when a member of the company grabs the vehicle at the surface, side of the pool. The old fountain may be removed from the vehicle and placed on the surface, side of the pool after the clock has stopped. If the old fountain is accidentally dropped after the clock has stopped, time will not restart, and the company will not receive a time bonus since all tasks were not successfully completed.

### **TASK 3: HEALTH: ENVIRONMENTAL CLEANUP**

Your company is tasked with collecting a sediment sample from the contaminated area and returning it to the surface. You are also tasked with returning two clams from the contaminated area and returning them to the surface. After recovering the sediment and clams, your company must place a cap over the contaminated area.

**This task involves the following steps:**

- **Collecting a sediment sample from the contaminated area:**
  - **Removing the sediment sample from the bottom – 5 points**
  - **Returning the sediment sample to the surface, side of the pool – 5 points**
- **Collecting two clams from the contaminated area:**
  - **Removing two clams from the bottom – 5 points each (10 points total)**
  - **Returning two clams to the surface, side of the pool – 5 points each (10 points total)**
- **Placing a cap over the contaminated area – 10 points**

**Total points = 40**

**Product Demonstration Notes:**

Companies may do the steps of this task in any order. However, once the cap is placed over the contaminated area, companies may no longer retrieve the sediment sample or clams from the contaminated area.

Companies may alternate between the steps of the Health: Environmental Cleanup task and the other product demonstration tasks.

Companies must collect a sediment sample and two clams from the contaminated area. The entire area around the sediment sample and clams will be considered the contaminated area.

The sediment sample will be constructed from a 4-inch end cap. A 40 cm length of 1/8-inch polypropylene rope will serve as a lift point for the sediment sample. Companies will receive 5 points for removing the sediment sample from the bottom. Removing the sediment sample from the bottom is defined as the end cap under control of the ROV and no longer in contact with the bottom of the pool. Companies must then return the sediment sample to the surface. Companies will receive 10 points when they place the sediment sample on the surface, side of the pool.

The sediment will weigh less than 5 Newtons in water.

The clams will be constructed from 2 cm to 3 cm segments of 1 ½-inch PVC pipe and 1 ¼-inch couplings. The clams will be contained inside a ½-inch PVC rectangle 30 cm by 20 cm. There will be at least 25 clams randomly distributed inside each rectangle; companies will only need to collect two clams. Companies will receive 5 points for each clam removed from the bottom, 10 points total. Removing a clam from the bottom is defined as the clam under control of the ROV no longer in contact with the bottom of the pool. Companies will receive 5 points for each clam returned to the surface and placed on the side of the pool, 10 points total. Companies may collect more than two clams, but will only receive points for collecting two.

Two clams combined will weigh less than 5 Newtons in water.

Companies must place a cap over contaminated area. The cap will be constructed from a Sterlite 6 Qt (5.7 L) plastic storage box lid with a PVC handle on top. The cap will be located on the bottom of the pool within 2

meters of the clam bed. The ROV must carry the cap down and place it over the 30 cm x 20 cm rectangle containing the clams. Companies will receive 15 points for successfully capping the contaminated sediments. Successfully capping the contaminated sediments is defined as the cap no longer in contact with the ROV and any part of the cap touching the 30 cm x 20 cm rectangle or a clam that is still inside the rectangle.

The cap will weigh less than 5 Newtons in water.

#### **TASK 4: SAFETY: RISK MITIGATION**

Your company is tasked with searching the area to locate the cargo containers. The containers became buried in the silt upon impact with the seafloor, obscuring any warning labels and making the Radio Frequency Identification (RFID) tag the only way to identify and determine their contents.

Once found, you must activate the RFID tag to determine each container's identification number. From there, you must match the identification numbers to a manifest of cargo containers to determine if the contents are high risk. You must also attach a buoy marker to the container with the highest-risk cargo.

**This task involves the following steps:**

- **Locating the two cargo containers – 5 points**
- **Inserting the sensor into the port on the side of each container to activate the RFID – 10 points each (20 points total)**
- **Using the RFID data to determine the containers identification number, contents, and if the contents are high risk – 5 points each (10 points total)**
- **Attaching a buoy marker to the U-bolt on the container with the highest-risk cargo – 15 points**

**Total points = 50**

#### **Product Demonstration Notes:**

The steps of this task may be done in any order.

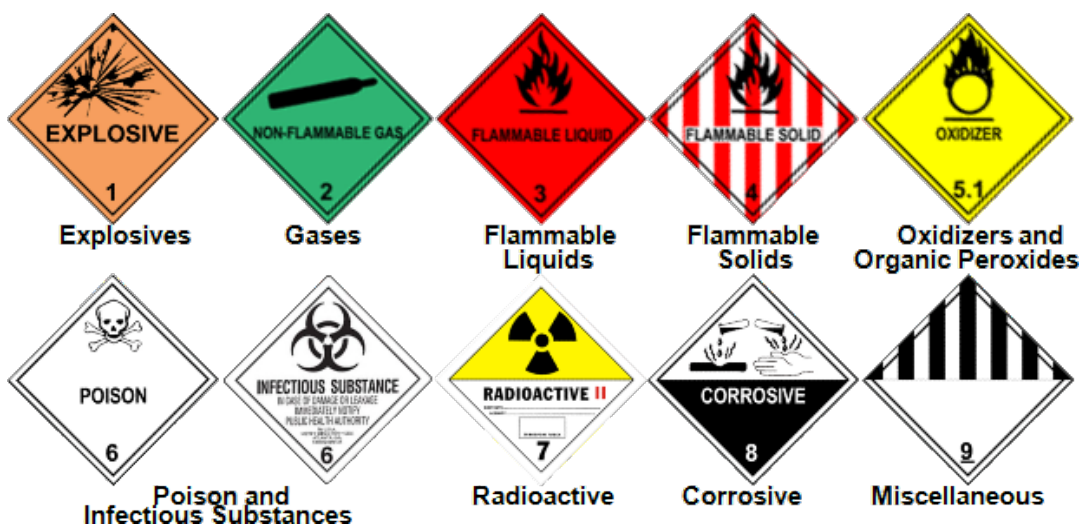
Companies must locate the two cargo containers. The cargo containers will be constructed from ½-inch PVC pipe. Both cargo containers will be approximately 50 cm long, 30 cm wide, and 30 cm high. Black stripes on the upper PVC framework will help to distinguish the two different containers. One container will have one black stripe on each side of the top of the container; the other container will have two black stripes on each side of the top of the container. Companies will receive 5 points when they show the product demonstration judge both cargo containers on their video monitor. Both containers do not have to be in view at one time, but the judge must see both containers via the video monitor before the 5 points are awarded.

The port on each container will be simulated by a red ½-inch PVC tee. The sensor will be constructed from a ½-inch PVC cross. The sensor / RFID interface will be simulated with a magnet and a magnetic reed switch. The

magnet will be on the sensor; the reed switch will be on the tee comprising the port. When the magnet is within range of the reed switch, the circuit will close and an LED light and buzzer will activate on the surface. Companies will receive 10 points for each of the two RFID circuits activated, 20 points total.

The sensor will weigh less than 10 Newtons in water.

The four LEDs on the surface will display four distinct colors. A **NAVIGATOR Container Manifest Handbook** will contain eight different manifests, each manifest corresponding to a distinct color. Companies must match the color of the LED to the proper manifest. The manifest will include the containers' identification number, contents, and a chemical hazard label. Companies must use the chemical hazard symbol to determine the risk potential for each container. Explosive, poison, toxic, corrosive, and radioactive elements pose the highest risk. Oxidizers and organic peroxides pose a moderate risk. In an underwater environment, flammable materials are considered only a moderate risk. Containers with items that pose no risk will not be marked with a hazard label. Companies will receive 5 points for each manifest and risk potential correctly identified, 10 points total. To receive points, companies must show the station judge the manifest for each container.



The Department of Environmental Health and Safety (EHS) classification chart for hazardous materials in shipping containers. <https://www.case.edu/does/ChemSafety/shipHazMat.html>

Companies must attach a marker buoy to the container with the highest-risk or most hazardous cargo. A #310 U-bolt will be attached to the top center of each container. The U-bolt will be the attachment point for the marker buoy. Companies must design and build their own marker buoy. The buoy line must attach to the #310 U-bolt, and a red or orange float must be on the surface. Other than those specifications, companies are free to design the buoy however they wish. Companies will receive 15 points when the buoy is successfully attached. Successfully attaching the buoy is defined as one end secured to the #310 U-bolt, the other end with a red/orange buoy floating on the surface.

Note: The company built marker buoy will not be included in the size and weight measurements, but must be part of the safety inspection.

**Time bonus:**

If a company has successfully completed all product demonstration tasks and is returning to the surface with positioning beacons, the old fountain, the sediment sample, and/or clams, the product demonstration time will stop when a member of the company touches the vehicle. Beacons, the fountain, the sediment sample, and/or clams on board may be removed and set on the pool deck after the clock has stopped. If any of these items is dropped from the ROV, the company will not receive points for returning the item to the surface, time will not restart, and the company will not receive a time bonus.

**PRODUCT DEMONSTRATION RESOURCES**

The [NAVIGATOR Container Manifest Handbook](#) contains eight potential cargo manifests for the sunken containers.

The [NAVIGATOR Product Demonstration Photos](#) contains photos of completed product demonstration props.

See the [NAVIGATOR Product Demonstration SolidWorks](#) files for CAD representations of the product demonstrations.

**PART 2: PRODUCT DEMONSTRATION PROP BUILDING INSTRUCTIONS & PHOTOS**

By popular request, this section has been removed and made into its own, separate document. This document will be released and posted by December 9<sup>th</sup>, 2016.

**PART 3: VEHICLE DESIGN & BUILDING SPECIFICATIONS****1.0 GENERAL****1.1 FAQs**

Questions about vehicle design and building specifications, as well as competition rules, should be posted to Competition Help within the [MATE Forum Hub \(www.marinetech.org/forums/\)](http://www.marinetech.org/forums/). This ensures that all companies can view the questions and answers and helps to avoid duplicate questions. That said, companies



should make sure that their questions have not already been asked – and answered – before posting. When posting their question, companies should reference the specific specification (e.g. ELEC-002N).

### 1.2 Documentation Required

As part of your [Technical Documentation](#), the following SIDs are required. If your regional competition does not require technical documentation, **these diagrams must still be submitted for review by safety inspectors on the day of the competition.** All symbols must be standard symbols as specified by ANSI, NEMA, or IEC.

DOC-001: Companies must provide a system interconnection diagram (SID) of their vehicle control system. An SID is an electrical diagram of their wiring, including their control box, motors, and any other electrical systems on their vehicle. The SID should separate and show what systems are on the surface and what systems are on the vehicle. The SID should not exceed one page in length. **The diagram MUST show an ROV system fuse. SIDs that do not show a fuse, utilizing an ANSI, NEMA or IEC symbol, with the size of the fuse marked, will not pass their safety check.**

#### **NEW in 2017!!!**

DOC-002: Any electrical diagram should use ANSI, NEMA, or IEC symbols. They should be neatly hand drawn or created using a CAD software program. SIDs included in the technical documentation MUST be created using a CAD software program. SIDs required for the safety inspection can be neatly hand drawn or created using a CAD software program.

ANSI: American National Standards Institute

IEC: International Electrotechnical Commission

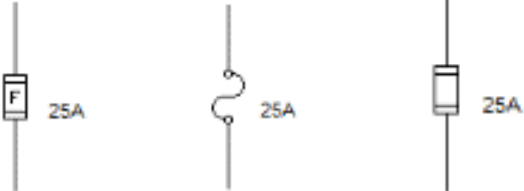
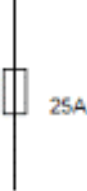
NEMA: National Electrical Manufacturers Association

Note: Companies may use free drawing software such as [OpenOffice](#) to create their diagrams.

DOC-003: Companies using fluid power (hydraulics or pneumatics) must provide a fluid power diagram. The diagram should separate and show what systems are on the surface and what systems are on the vehicle.

DOC-004: All symbols used in documentation must be in ANSI, NEMA or IEC format.

DOC-005: The following ANSI and IEC symbols are acceptable symbols for all MATE required documentation

Item	ANSI	IEC
FUSE		

## 2.0 SAFETY

Safety is the competition's primary concern and guiding principle. Any system that is considered unsafe by competition officials will not be allowed to compete. If a safety concern is found during the initial safety inspection, companies are permitted to attempt to modify their system and have it re-inspected. However, the competition schedule will NOT change to allow companies more time. Companies are allowed to have their vehicle re-inspected twice. If a company fails to pass its third and final safety inspection, it is disqualified from the underwater competition portion of the event. There are NO APPEALS once your ROV has been disqualified.

### Examples of safety violations from previous ROV competitions include:

- No SID was provided at the safety check.
- The SID included in the technical documentation did not show a main fuse or circuit breaker.
- The ROV used pneumatics, but the technical documentation did not include a pneumatics diagram.
- Sharp items, or potentially sharp items, (fishing hooks, glass bottles) were included on the vehicle.
- The vehicle motors were not waterproofed.
- Propellers were not protected inside the framework.

### 2.1 Safety inspection protocol

1. Before entering the water for practice or a product demonstration run, the ROV system **must** go through a safety inspection. Once the company successfully passes inspection, they will turn in their safety inspection sheet and be presented with a Green PASSED Flag. Companies must present the PASSED Flag to the pool practice/product demonstration coordinator before their vehicles are permitted to enter the water. Each company's flag will be uniquely identified with company number on the flag.
2. At the start of the safety inspection, companies must submit a systems interconnection diagram or SID. Competition staff will conduct a safety inspection of the vehicle using the SID and the [safety inspection sheet](#).
3. If the safety inspector(s) identify a safety violation, companies will have the opportunity to address it. The pool practice or product demonstration run schedule will NOT change to allow companies more time.
4. If during the second safety review the
  - a. violation has not been properly addressed or
  - b. another violation is foundcompanies will have ONE more opportunity to address the issue.
5. If during the third safety review a violation still exists, companies will not be permitted to participate in the underwater product demonstration component of the competition. However, companies can still participate in the engineering and communication (technical documentation, product presentation, and marketing display) component.
6. Reminder: All companies must present the Green PASSED Flag to the pool practice or product demonstration judge before placing their vehicles in the water. In addition, product demonstration station judges and competition officials can pause or stop a product demonstration run at any time if they feel that there is a potential safety concern.

Your regional competition may use a system other than a Green PASSED Flag, but all companies must pass a safety inspection before entering the water. Contact your [regional coordinator](#) to determine if a Green PASSED Flag will be used for safety verification or another system will be used.

## **2.2 Safety Inspection Completed**

Companies must complete their safety inspection before entering the water for practice or a product demonstration run on the day of the competition.

## **3.0 SPECIFICATIONS**

The ROV system (or “system”) must meet the following requirements:

### **3.1 Operational**

#### **3.1.1 Multiple Vehicles**

OPER-001: MULTIPLE VEHICLES ARE NOT PERMITTED. Companies are required to design and build ONE ROV that can complete the necessary product demonstration tasks. “Floating eyeballs” or other vehicles that are not hard connected to the frame of the main vehicle are NOT permitted. Cameras designed to provide a “birds-eye view” are permitted provided that these cameras are hard connected to the frame of the main vehicle. “Hard connection” does not include the wiring between the camera and the ROV.

#### **3.1.2 Environmental**

OPER-002: The ROV system must be able to function in fresh, chlorinated water with temperatures between 15°C and 30°C. The water should be considered conducive of electrical currents.

OPER-003: The pool will not be covered or purposefully darkened in any way, although the specific product demonstration tasks may require that your ROV operates in low-light.

OPER-004: No water currents will be intentionally created. However, depending on the venue, pressurized pool filtration system outlets may cause unexpected currents.

OPER-005: Regional competitions may be held in pool venues with different environmental conditions than those listed here. If you are unfamiliar with the regional pool, contact the [regional coordinator](#) in your area.

#### **3.1.3 Service Requirement**

OPER-006: Companies shall provide a product demonstration team of up to 4 people to operate the ROV on the pool deck. Companies may be composed of more than 4 people, but only 4 company members are

allowed on the pool deck to operate the vehicle. More information about this “product demonstration team” is provided in the [COMPETITION RULES](#).

### ***3.1.4 Calibration Requirement***

OPER-007: All measurement devices shall be calibrated according to manufacturer recommended calibration procedure and performed by company members only. Company mentors or advisors are not permitted to perform calibration procedures. More information about mentor restrictions is provided in the [COMPETITION RULES](#).

### ***3.1.5 Maintenance***

OPER-008: System maintenance during field operations shall be conducted by ROV personnel at their workstations. Work of any kind must not be done by company mentors or advisors. All maintenance parts and equipment necessary to meet the operation requirements shall be provided by the company. More information about these regulations is provided in the [COMPETITION RULES](#).

## **3.2 Mechanical/Physical**

This section of the document provides specifications for the mechanical properties of the ROV system.

### ***3.2.1 Materials***

MECH-001: Any electronics housings on the ROV shall be capable of operating to depths of 4 meters.

### ***3.2.2 Size***

MECH-002: ROVs are not limited to a maximum size, but companies must be able to personally transport the vehicle and associated equipment to the product demonstration station and to the product presentation room. ROV systems must be capable of being safely hand launched. Additional points will be given to smaller, lighter vehicles (see [Size Restrictions](#)).

### ***3.2.3 Tether Length***

MECH-003N: ROVs must be capable of operating in a maximum pool depth of 4 meters (13 feet). All underwater product demonstration will take place within 8 meters from the side of the pool. The product demonstration station will be no more than 3 meters from the side of the pool. Tether length should be calculated accordingly.

**Note:** Many NAVIGATOR class competitions are held in water less than 4 meters deep. Contact your [regional coordinator](#) to determine the maximum depth of the NAVIGATOR competition.

### **3.2.4 Vehicle Deployment and Recovery**

MECH-004N: The product demonstration team (up to 4 people) must be able to carry the entire vehicle by hand. The crew must be able to hand launch and recover the ROV. No lifts or levers may be used to launch the ROV.

### **3.2.3 Propellers**

MECH-005N: Propellers must be enclosed inside the frame of the ROV or shrouded. Companies that have propellers protruding outside of their frame will not pass the safety inspection and will not be allowed to compete.

## **3.3. Electrical**

ELEC-001N: All power provided to your ROV system must be obtained from the MATE competition power supply. This is a singular point of connection; all power to your ROV must pass through the MATE-provided fuse on the supply AND the single fuse in your wiring.

ELEC-002N: MATE will provide a nominal 12 volt power source at the product demonstration station. This power source may be a battery or a power supply. Nominal voltage may be as high as 14.8 volts.

ELEC-003N: Voltage may never be increased above the nominal 12 volts anywhere in the ROV system.

### **Current**

ELEC-004N: The ROV **MUST** have a 15A maximum fuse in the positive power supply line within 30 cm of the positive banana plug. The SID must show this fuse and include the amperage rating of the fuse.

ELEC-005N: ROV systems are allowed two replacement fuses during the product demonstration run. In the event that the ROV system blows the third fuse during the product demonstration, the product demonstration run will be over and no additional points will be earned. Note: Companies must provide their own replacement fuses. MATE will not provide replacement fuses.

## **IN 2017!!!**

### **Power Connections**

ELEC-006N: This year, the MATE Center requires that all ROVs transition from banana plug connections to Anderson power pole connections ([www.andersonpower.com/us/en/products/powerpole/pp15-to-45.aspx](http://www.andersonpower.com/us/en/products/powerpole/pp15-to-45.aspx)). All SCOUT class competition vehicles are required to use Anderson power pole connectors. Power supply connections at all regional competitions will be Red/Black Anderson Powerpole Connectors.

Anderson power pole connections are two-piece connectors as shown in the picture below.



### Part specification and part numbers

Anderson Power Pole – Red and Black connector with 30 amp contacts

Red is connected to power supply positive.

Black is connected to power supply negative.

Since Anderson sells the connectors in 2500 and 200 piece quantities, these connectors are available from distributors.

For those who want more information on Anderson power pole connectors:

Distributor Part Number:

Connector & Pins: Powerwerx WP30-10 (This is a kit with 10 connector sets and 30 amp pins for approx \$12 USD)

Recommended Crimper: TR1crimp

<http://www.powerwerx.com/crimping-tools/tricrimp-crimping-powerpole-contacts.html>

Connector Sources:

<http://www.powerwerx.com/anderson-powerpoles/powerpole-sets/30-amp-permanently-bonded-red-black-anderson-powerpole-sets.html>

<http://www.aesham.com/power-distribution/powerpoles/powerwerx-wp30-10/>

[http://www.gigaparts.com/Product-Lines/Power\\_2/Powerwerx-WP30-10.html](http://www.gigaparts.com/Product-Lines/Power_2/Powerwerx-WP30-10.html)

<http://www.hamradio.com/detail.cfm?pid=71-001833>

### Powerpole related links

Powerpole Data Sheet

[http://www.andersonpower.com/\\_global-assets/downloads/pdf/ds-pp1545.pdf](http://www.andersonpower.com/_global-assets/downloads/pdf/ds-pp1545.pdf)

Powerpole Description

[https://en.wikipedia.org/wiki/Anderson\\_Powerpole](https://en.wikipedia.org/wiki/Anderson_Powerpole)

Powerpole Assembly Instructions

<http://www.powerwerx.com/assembly.asp>

<http://www.wb3w.net/powerpoleinst.htm> (see the section on using the TriCrimp tool)

YouTube video for Assembly

Part 1: [https://www.youtube.com/watch?v=8\\_DPPuQN8R4](https://www.youtube.com/watch?v=8_DPPuQN8R4)

Part 2: <https://www.youtube.com/watch?v=EsSsr2zGFqI>

ELEC-007N: The power supply may be located up to 1 meter from the station table and may be located on either side of the table. MATE recommends a power cable long enough to reach the power supply up to 3 meters from your control system.

### ***3.3.1 Tether Voltages***

The signals in the tether must meet the following specifications:

ELEC-008N: Low voltage, low current AC or DC control or sensor signals. Low voltage is defined as a voltage equal to or less than the maximum supply voltage per class specification. Low current is defined as being less than 500mA.

**Note:** Companies concerned about how voltage loss will affect their camera(s) should consider adding a separate line in the tether to supply the camera from the main power source. This dedicated line for cameras is permitted, provided it runs through the single fuse or circuit breaker.

ELEC-009N: DC main-supply at a nominal voltage of 12VDC as provided by the MATE power supply.

ELEC-010N: Ethernet, USB, or other ANSI or IEC accepted serial protocol signals.

All cameras, including USB cameras, must be powered by the MATE supply. Power a USB camera from the MATE supply can be accomplished by using a USB repeater / extender that has a separate power input at the far (ROV) end. The ROV would then provide the power to the device from the MATE supply. USB cameras directly plugged into laptops or surface computers are not allowed.

ELEC-011N: NTSC or PAL Video signals

ELEC-012N: Fiber optic cabling of any type may be used.

### ***3.3.2 Exposed connections and disposable motors***

ELEC-013N: ROVs with electrical connections that are exposed to water and not sealed are not permitted to enter the water. Taping a connection with electrical tape only does not constitute a sealed connection. The process of sealing electrical connections must include methodologies such as, but not limited to, Silicone RTV, hot melt glue, epoxy, self-vulcanizing tape, and enclosure of the connections in a housing.

ELEC-014N: “Disposable motors” are not permitted; these are exposed motors with no waterproofing.

### 3.4 Onboard Electrical Power

ELEC-015N: Onboard electrical power (i.e., power not provided by the tether): Onboard battery powered devices are NOT allowed under any circumstance.

**NOTE:** *Water leaking into a closed battery container can result in the generation of hydrogen gas. This gas can build up inside a pressure housing and create an unsafe situation. For this reason, onboard batteries are NOT allowed under any circumstance. Any device that needs power must obtain that power directly from the ROV tether. For devices that operate at a voltage other than the tether voltage, an onboard ROV converter may be included. The converter must be sealed and not exposed to water. This rule includes commercial “watertight” battery containers; no battery of any type is permitted on any competition vehicle.*

### 3.5 Power Shutdown

ELEC-016N: For safety purposes, any ROV system that is disconnected from the surface supply must stop functioning in less than 5 seconds. This applies to electrical, pneumatic, and hydraulic power sources. Any filters, capacitors or accumulators must be sized accordingly to meet this specification.

### 3.6 Fluid Power

Any vehicle using fluid power must provide a fluid power diagram. Fluid power is hydraulic pumps (water) or pneumatic pumps (air) on the vehicle or on the surface.

FLUID-001N: Electrical pumps of any sort are NOT allowed. Companies may only use manual pumps (hand or foot pumps) to push fluids down the tether and to their vehicle.

FLUID-002N: Companies may only use WATER as their hydraulic fluid. Companies may only use AIR as their pneumatic fluid.

FLUID-003N: Companies may not use pressure accumulators. Pressure inside any container must never exceed the ambient pool pressure. If air is pumped into a container on the vehicle, that container must be open to the water. Vent holes on the container must be at least ¼-inch (6.35 mm) in diameter.

For example: A company wants to fill a PVC pipe container on the vehicle with air. Companies may only use a manual pump (hand/foot powered bicycle pump) to push air down to the vehicle. The company drills four ¼-inch holes in the bottom of the pipe. As they pump air into the container, it will displace the water out of the holes in the bottom of the pipe. However, the pressure inside the container can never get above the ambient pool pressure; excess air will come out the holes on the bottom of the pipe once all the water has been displaced.



### 3.7 Control Systems

ELEC-017N: Control systems must be built in a neat and workmanship like manner. Loose components and unsecured wires may not pass safety inspection. All wires entering and leaving the control system must have adequate strain relief and wire abrasion protection as the wires pass through the box.

#### **NEW in 2017!!!**

ELEC-018N: If the surface control station combines 120VAC and 12VDC wiring, the 120VAC wiring must be physically separated from the DC wiring, clearly identified from the DC wiring, and every conductor insulated in a manner that no conductor is exposed. Identification can be through signage and/or wire color schemes. All 120VAC wiring colors must use ANSI, NEMA or IEC standard wiring colors appropriate to each voltage. There must be a sign inside the surface control station indicating which wiring standard is being utilized. Companies that do not have adequate separation of AC wires and components and DC wires and components will NOT pass the safety inspection. It is recommended that separation be designed into the control system to keep power systems separate. Wiring should be clear, neat, and easy to follow by inspectors. Wiring “rats nests” or “spaghetti wiring” will not pass safety inspection.

### 3.8 Cameras and monitors

CAM-001N: Companies are limited to ONE video display screen. This display screen may be powered by the MATE provided GFI-protected 115-Volt AC (60-cycle) and 15-amp AC power source described in CAM-002, Surface power.

CAM-002: Surface power: MATE will provide one GFI-protected outlet with a nominal 115 Volts AC (60 Hertz) and 15 amps maximum. This outlet is intended to provide power for the video monitor. This AC power source CANNOT be used to directly or indirectly power the vehicle.

#### **MATE Provided Equipment**

MATE will not provide monitors at NAVIGATOR product demonstration stations this year. Companies are responsible for providing their own video monitor.

### 3.8. Lasers

NAVIGATOR class companies may NOT use lasers on their vehicle.

## PART 4: COMPETITION RULES

### GENERAL

- All members of the company and their supporters must follow the safety regulations of the ROV competition, pool facility, and event venue.
- All company members and their supporters are expected to conduct themselves in a professional and responsible manner during the competition. Disrespectful behavior towards the judges, officials, pool staff, audience, or other companies will lead to penalty points or disqualification.
- Sabotaging, stealing, or pilfering equipment of other companies will lead to disqualification. Companies found cheating will also be disqualified.
- The MATE ROV competition is, at its core, designed to be an educational and inspirational event for **STUDENTS**. It is designed to challenge them to apply the physics, math, electronics, and engineering skills they are learning in the classroom to solving practical problems from the marine workplace. (See the [MATE Competition Philosophy](#).)

It is expected that all “adults” (non-students; e.g. teachers, mentors, parents) involved in the competition limit their input to educational and inspirational roles. Actual construction of the ROV (particularly in the complex electrical and software areas) must be completed by the students. Adults should teach and advise students about design, electronics, software, and construction, but not complete the work for the students. Throughout the process adults are encouraged to focus on benefits to the students from the process and not simply winning. If it becomes apparent that adults exercised more than an advisory role, judges reserve the right to deduct points or, in extreme cases, disqualify companies from the competition.

While at any MATE ROV competition (international and regional), **ALL** work done on the vehicle must be conducted by company members. Teachers, mentors, parents, and non-competing students are not permitted to work on the ROVs. They may provide advisory input, but they may not work on the ROV directly. This includes writing or editing software code. All mechanical electrical and software modifications and/or repairs to the ROV must be completed by students.

- With learning at its core, the MATE competition encourages students to utilize and build upon their skill sets to find creative solutions to designing and building their ROV. As they move through the process of analyzing their designs and identifying building materials, students may decide to either build a component from “scratch” or purchase it from a commercial vendor.\*\*\* While original solutions are encouraged, the use of commercial components is acceptable, provided 1) that the components adhere to the design and building as well as safety specifications for the particular

competition class and 2) more importantly, that the students can provide a reasonable, logical explanation for buying versus building.

The competition scoring rubrics are designed to reflect this; points are awarded based on students' abilities to explain and justify how all of the components and systems work together as an integrated ROV, regardless if they purchased them, pulled them from public libraries, or made them themselves.

\*\*\*Note "commercial vendor" includes the SeaMATE store and other competition programs that sell educational robotics kits. SeaMATE kits were created to remove barriers to participation for teachers and schools unable to easily 1) find parts and materials and 2) set up accounts with multiple vendors. The kits are part of a larger educational package offered by the MATE Center that includes curriculum materials, videos, and other resources to support and enhance learning. And learning is what students who use SeaMATE (or other) kits will be expected to demonstrate during and through the [ENGINEERING & COMMUNICATION](#) components.

It should be noted that purchasing and competing with complete, assembled, commercial ROVs are not permitted.

## PROCEDURAL

- Companies must compete during their assigned time slots. Your company is **NOT** permitted to switch time slots with another company. Failure to show for your scheduled product demonstration or for your company's product presentation will result in "no score" for that particular competition category. **No exceptions.** Assigned time slots will be sent out in advance so that any scheduling concerns can be addressed prior to the event.
- Companies must complete their size measurements before each product demonstration run. The size measurements are included as part of the product demonstration score. Companies should be at the size in area at least 30 minutes before their scheduled product demonstration run.
- While there is no limit to the number of students who can compete as part of a company, **the product demonstration team (aka demo team) is limited to four students.** The demo team is defined as the team of students who operate the vehicle and its associated equipment during the product demonstration. Only four students will be allowed to enter the product demonstration station, launch, pilot, and perform the tasks. Instructors, mentors, and/or non-student members cannot participate as part of the demo team. **Companies may alternate students on the demo team for the two product demonstration attempts.** (All members of the company should participate in the engineering and communication components; see [ENGINEERING & COMMUNICATION](#) for more information.)

- Only the demo team members and judges are allowed at the product demonstration station during the product demonstration, which includes the set-up and demobilization periods. Other members of the company, instructors, mentors, audience members, and observers (press or special invited guests) must remain outside the product demonstration station or in designated viewing areas.
- Instructors, mentors, parents, and “fans” are **NOT** permitted at the safety inspection stations or repair tables. Two warnings will be issued before individuals not heeding this rule will be asked to leave the venue.
- In addition, instructors, mentors, parents, and fans are **NOT** permitted to work on the ROV. Individuals who are seen working on the ROV who are not student company members will be issued a warning. Two warnings will be issued before individuals not heeding this rule will be asked to leave the venue. If companies choose to take their ROVs off the competition grounds for maintenance and repair, they are expected to observe this rule in the interests of the spirit of the competition.
- To help enforce this, teachers, mentors, parents, and non-competing students MAY have limited access to the work station areas. Limited access can mean that these individuals are not permitted into the room or building where the workstations are located. Contact your [regional coordinator](#) or the [MATE Center \(jzande@marinetech.org\)](mailto:jzande@marinetech.org) for more information.
- Video devices may be used to record the underwater activities for entertainment and learning purposes **only**. Video will not be used as an instant replay to review judges’ decisions or to challenge product demonstration timing.
- Product demonstration stations will be roped off and marked. Product demonstration stations will contain 2-3 chairs and one 6-foot table long table for companies to use. This table will be within 3 meters of the pool edge. Product demonstration stations will be set up to prevent the pilot(s) from looking at the ROV in or under the water except through the ROV cameras.
- Companies will compete in one product demonstration that will consist of four tasks. Companies will get TWO attempts at the one product demonstration. The higher of the two scores will be added to the engineering and communication score to determine the total, overall score for the competition.
- The product demonstration time consists of a 5-minute set-up period, a 15-minute performance period, and a 5-minute demobilization period. If the demo team and all of their equipment are not out of the product demonstration station at the end of the 5-minute demobilization period, the company will be **penalized 1 point for each additional minute**.

**Note:** Regional competitions *may not* offer two attempts at the product demonstration. Regional competitions may allow more or less time to complete the product demonstration. Contact the [regional coordinator](#) in your area for more information.

- Manipulating the tether to free it from underwater obstacles is permitted. Pulling on the tether to speed up the recovery of items or to return your vehicle more quickly to the surface is not permitted and will result in penalty points. Judges will issue one warning if tether pulling occurs. Each future infraction will result in **5** points deducted from the final product demonstration score.
- If your vehicle is completely disabled and/or its tether tangled and unable to free itself from the underwater environment, SCUBA divers can be called in to assist. However, the product demonstration time will NOT stop and **5** points will be deducted from the final product demonstration score.
- **Note:** Some regional events may not provide SCUBA diver support. If that is the case, ROVs that become tangled and unable to free themselves or are otherwise disabled will not be “rescued” by a SCUBA diver until the product demonstration time is over. Unfortunately, that means that no additional product demonstration points can be received. Contact the [regional coordinator](#) in your area to determine if your regional will have SCUBA diver support during your product demonstration run.
- Pilots can only leave the product demonstration station and move poolside to repair, adjust, or alter a vehicle if the ROV is surfaced and at the side of the pool.
- Companies are not permitted to leave debris in the pool. Any debris must be recovered by the ROV before time has expired or the company will be penalized. Debris is defined as pieces of the ROVs, weights, floats, or other items created by the company. Task props are not considered debris. The product demonstration notes section may cover special items that can be left in the pool after time has expired.
- No demo team member shall enter the water to complete an object recovery. Only arms and hands are allowed into the pool to retrieve an object or to retrieve the vehicle. Companies will be disqualified or penalized depending on the severity of the infraction.
- Communication between demo team members at the pool edge and demo team members piloting the vehicle will be limited. Only tether management issues (e.g. how much tether is out, how much is remaining on the pool deck) can be discussed. Those team members at the pool edge cannot give any directional or product demonstration task information to the pilot. Judges will issue one warning regarding illegal communication. Each future infraction will result in **5** points deducted from the final product demonstration score.

- Communication using cell phones, text messaging, and online social media tools such as Skype, Facebook, Twitter, instant messaging, etc. is NOT permitted during the product demonstration, either between the demo team members at poolside or between any demo team member and anyone outside of the product demonstration station. The ROV and/or the ROV control system is not allowed to broadcast video or other information to anyone outside of the product demonstration area. No exceptions. Companies found broadcasting any data to those outside of the product demonstration area will be disqualified.
- **Product demonstration judges and other competition officials will only communicate with students.** Judges and officials will NOT communicate with mentors, parents, or other non-student members regarding product demonstration information, challenges, or other issues except during pre- and post-competition briefing sessions.

Companies that wish to issue a challenge during the product demonstration run should immediately communicate this challenge to the product demonstration judges. The judges will discuss and attempt to resolve the issue. If a decision cannot be made, the product demonstration judges will consult with the head judges and competition technical manager to resolve the issue.

## DESIGN & SAFETY CONSIDERATIONS

- The competition coordinators and host venues stress the importance of safety practices and procedures to all companies. The score sheets and rubrics will reflect the MATE Center's efforts to encourage and reward companies that demonstrate exceptional safety practices and procedures.
- **ALL ROVS MUST PASS A SAFETY INSPECTION CONDUCTED BY COMPETITION OFFICIALS PRIOR TO ENTERING THE POOL.** These inspections will be conducted topside to ensure that ROV systems meet the design and building specifications and do not pose a risk to the integrity of the event venue. See [VEHICLE DESIGN & BUILDING SPECIFICATIONS](#) for additional information.
- Radio transmitters that operate on a separate battery are permitted. No batteries are permitted to be in or on the water. No exceptions.

Companies should be aware of all the implications of these wireless devices. There is no assurance that an adjacent company's wireless controller will not interfere with your control systems. Adjacent wireless controllers with a battery that has a higher charge than the nearby controller have demonstrated the ability to "hijack" the nearby control signals. In addition, all wireless controllers are susceptible to external sources of electronic interference. Your system may work fine in your home environment, but not in the industrial environment of the competition. MATE will not stop the clock to resolve wireless control issues. Companies deciding to utilize wireless controllers do so at their own risk.

- Keep an eye out for tripping hazards in the product demonstration station and at your company's work station. Make sure power cords are not laying in pools of water on the deck.
- During your product demonstration, be sure to secure any equipment so that it does not fall off the product demonstration station table, damage the deck, or cause injury.
- Loose fitting clothing, jewelry, and long hair could all become safety issues. Consider securing long shirts or baggy pants, removing jewelry, and tying back long hair when working on or operating your ROV.
- ROVs may be constructed out of materials of your company's choice, provided they meet the design and building specifications and safety regulations. Warning labels should be posted on potentially hazardous components of your ROV system.
- Close toed shoes are required on the pool deck. Safety glasses are required when working on the vehicle.
- Personal flotation devices (PFDs) may be required when launching and recovering your vehicles. Contact your [regional coordinator](#) to determine whether this is a requirement at your regional event. If PFDs are required, they will be provided by the regional coordinator.

## PART 5: ENGINEERING & COMMUNICATION

The ability to effectively communicate information about your vehicle and the design and building process is equally as important as how well your vehicle performs. Strong communication skills are an essential part of good business practices. To emphasize this point, the competition requires the following three engineering and communication components:

- Company Spec Sheet
- Technical Documentation (formerly known as the technical report)
- Product Presentation (formerly known as the engineering presentation)
- Marketing Display (formerly known as the poster display)

**NOTE: Regional contests may not require all of the Engineering & Communication components. Contact your [regional coordinator](#) for more information.**

The Company Spec Sheet, Technical Documentation, and Product Presentation are components where you are communicating with technical audiences, such as potential future clients. (Examples of spec sheets and technical documentation from previous competitions can be found

[www.marinetech.org/tech-reports](http://www.marinetech.org/tech-reports). Examples of product presentations can be found on [MATE's Vimeo channel](#).) The Marketing Display should be thought of as part of your marketing (or sales) strategy and aimed at general (including non-technical) audiences.

## **TIPS FOR EFFECTIVE WRITTEN AND ORAL COMMUNICATION**

Communicating ideas about how to solve a problem and evaluating those ideas is a critical skill for anyone thinking about a career in marine technology. It is a skill that is directly linked to decision making about whether or not to hire (or fund) us and our ability to affect the work that we do.

The key to a successful technical documentation and product presentation is the way that critical thinking and engineering reasoning are communicated. You can think of the process as technical “storytelling.”

Technical storytelling includes the use of text, images, diagrams, and data to communicate the “story” of how your company brainstormed and evaluated ideas to come up with your solution (e.g. ROV, payload tools) to the problem at hand (tasks). It also involves organizing the information to efficiently present your work and justify why you did what you did.

However, choose details with care. Each detail should help to answer the question “why is what you did the best solution for your company and for this competition?” Describe why a component in the system is critical and how you chose it. Include specifications or dimensions only if they help to explain the “why” and “how” you made choices. Keep in mind that a mechanical drawing with dimensions can replace a lot of text and in many cases do a better job telling details of the story than text.

That said, if something is hard to describe clearly and completely with two to three sentences, consider whether using an image may help. A good technical document balances text and images to provide lots of information concisely, giving a detailed understanding while being quick and easy to read. Remember that your reader is new to your design and needs to understand both what your design is and the process you used to get there. Present text and images in a logical order that helps readers follow your development process and results.

Maintaining a project notebook is a good business practice that will help to capture ideas and keep track of your company’s progress – including your research, designs, trade studies, experiments, data, vehicle specifications, testing, expenditures, and donations. The notebook is also a place to write down your company member’s contributions (time, support, etc.).

Along with your notebook, here are some items to consider as you prepare to tell your story via your documentation and presentation:

- What was your company's "work breakdown structure" (tasks, time, and people)?
- What were the greatest limitations (schedule, budget, equipment, labor, logistics, etc.) on your design process?



- How did the product demonstration and rules influence your design and decisions?
- What process, such as a [tradeoff matrix](#), did you use to evaluate competing design solutions?
- What were the most important design decisions you made and why?
- Did you have a noteworthy troubleshooting experience? Any problem or procedure that takes more than 20 minutes to figure out is worth understanding and writing down.

## COMPANY SPEC SHEET (ONE PAGE ONLY)

The goal of the Company Spec Sheet is to provide the judges with a “snapshot” of your company. It includes basic information about your company and vehicle.

Companies must submit their spec sheets to their [regional coordinator](#), along with (but as a separate document from) their technical documentation (see below).

Companies will receive up to 10 points for submitting a spec sheet that follows the file size and naming specifications and contains all of the following information:

### COMPANY SPECS

- **Company and school, club, or community organization name**
- **Home state and/or country**
- **Distance required to travel to the international competition**
- **History of MATE ROV competition participation.** Be sure to specify if your company and/or the members of your company are “new” or “returning.”
- **Company photo and caption indicating members’ names and roles (e.g. CEO, CFO, Design Engineer, Pilot, etc.).** This photo should include all of the members of your company.
- **Range of grade/college levels represented by the members of your company**

### ROV SPECS

- **ROV name** if applicable
- **Total cost.** You must include the approximate cost of any donated items.
- **Size measurements**
- **Total student-hours to design and build.** This should include the number of hours that each and every member of the company worked on the vehicle.
- **Safety features**
- **Special features**
- **Photo of the vehicle**

## TECHNICAL DOCUMENTATION

Your company is required to submit technical documentation that will be reviewed and evaluated by a panel of working professionals – individuals who represent science, exploration, government, and industry. (These individuals may not be the same judges who evaluate your company’s product

presentation.) The technical documentation is a means for your company to describe the design, operations, and features of your vehicle. Your clients should gain a good technical understanding of your vehicle and your company's capabilities in addressing your client's needs for an ROV.

The deadline for submitting this documentation will vary among regionals. Contact your [regional coordinator](#) to find out your specific deadline.

NOTE: By submitting your technical documentation and company spec sheet, you are giving the MATE Center permission to publish these documents on its web site.

Each judge will evaluate and award a score (50 points max). Judges' scores and comments will be returned to you shortly after the event.

**The requirements and guidelines for the technical documentation are:**

- **Length must be 10 pages or less**
- **Font size must be at least 12 points**
- **Recommended font types are Times New Roman, Arial, or Calibri**
- **All measurements must be in SI units (metric), except for PVC pipe diameter (e.g., ½-inch) and other items commonly described using imperial units**
- **Title page** that includes:
  - Your company's name
  - School, club, or community organization's name, city, state, and country.
  - **COMPLETE** list of the members of your company and their role (CEO, CFO, pilot, etc.). You can also include grade level/career goals and expected graduation date.
  - **Names** of your instructor(s) and/or mentor(s).
- **Abstract (no more than 150 words)** that is concise and clearly summarizes the project.
- **Photograph(s) of your completed ROV**  
Include photo(s) of your completed vehicle and other photos or sketches that capture the vehicle's design features. Captions should accompany all photos.

You are permitted to make modifications that may change the look of your vehicle between the time you submit your report and the competition; however, in your technical documentation you must include a photo(s) of your completed, assembled vehicle, in addition to any photos of individual systems and/or payload.

- **Budget**  
At the beginning of the project, companies should establish a budget. A budget is a projection of the cost of the project. Companies should create categories and realistically estimate what they think that they will spend in each. Then, during the project, you should keep an accounting of your income, donations, and expenses. This includes items (building materials, equipment, travel stipends, etc.) that were donated and items that were re-used from previous years. For donated items, make sure that you list the organization or individual who made the donation.

For both donated and re-used items, make sure that you include an estimate of the item's present-day value.

**Tip:** Ask your school's business or accounting office for examples of budget sheets.

▪ **Systems Integration Diagram (SID)**

A SID (also called a block diagram) is a system-level diagram showing how major system (electrical, mechanical, hydraulic/fluid) components are connected is required. The SID provides readers with a graphical map of the major components and signals needed to understand the design at a high level. It should make clear which parts of the system operate above and below the surface. It should answer the questions "What and where are major parts of the system?" and "What main signals (power, data, electrical, fluid, mechanical) flow between the components?"

The SID will be evaluated on how well it shows the relationship between major system components at an appropriate level of detail (not too much, not too little).

**Requirements**

- The SID must be drawn using a computer drawing tool (e.g. OpenOffice (free), Inkscape (free) Power Point, Word, Paint, Visio, Omni Graffle, etc.)

**Recommendations**

- Using industry standard symbols and drawing conventions (ANSI, NEMA, IEC) is strongly encouraged. Using a standard ANSI, NEMA or IEC symbol for the fuse is **REQUIRED!** (See specifications for acceptable fuse symbols).
  - Components and signals (power, control, data) must be labeled.
  - Read the [VEHICLE DESIGN & BUILDING SPECIFICATIONS](#) for more information about the SID.
- **Design rationale** presented in a clear and logical manner. This section should comprise the bulk of your documentation. ***It should focus on the technical aspects of your vehicle and how your ROV was built to perform the specific tasks.*** It should include information about your planning and design process, how you thought through ideas, and why you made the design choices that you did. It should explain any troubleshooting techniques and note any skills that you gained. See the questions under Product Presentation below for an example of information that you should cover.
- **Safety.** This section should describe the steps that your company has taken to identify and fix any safety concerns in order to make sure that your vehicle and its operation are **SAFE**. *Safety is paramount!* Your company should reflect that within this section.
- **Designs tested, pitfalls encountered, and lessons learned during the design and building process**
- This section should describe the technical challenges that your company faced during the design and building process and the lessons learned and skills gained that allowed you to overcome

them. In addition to technical challenges, you may include descriptions of challenges related to project management, working as a team, understanding business practices, etc.

- **Discussion of future improvements**

In this case, the MATE Center is your “client” and has defined both the problem to be resolved and the products and services you need to provide. However, future clients could include research institutions, private companies, and government agencies. How would you improve your ROV for a future client?

- **Acknowledgements**

Please recognize your sponsors (companies, organizations (including the MATE Center), professionals from industry, and/or mentors) and the type of support that they provided (funds, building supplies, equipment, site visits to facilities, time, and/or technical expertise). You can include organizations and/or individuals that provided logistical and/or moral support (e.g. your parents, siblings, or pets). Regional competition companies should also acknowledge regional contest supporters.

- **References**

All reference materials such as books, journal articles, magazines, trade publications, software, web sites, and professional advice that you used for your project must be acknowledged. Consider using the Chicago Manual of Style (<http://www.chicagomanualofstyle.org/home.html>) format for the reference list. Web sites like the Citation Machine (<http://www.citationmachine.net/>) make it easy to generate citations in this format.

## PRODUCT PRESENTATION

During the competition, your company is required to give a 15-minute oral presentation to a panel of working professionals – individuals who represent science, exploration, government, and industry. (These individuals may not be the same judges who evaluate your company’s technical documentation.) Your presentation should describe the engineering behind your vehicle’s design and operation and address any possible safety issues. It should also highlight any design innovations or creative solutions to solving the product demonstration tasks. After the presentation, the judges will take 10-15 minutes to ask the members of your company questions about your ROV. The judges will evaluate both your presentation and responses to their questions.

**All student members of your company must participate in this presentation and question and answer (Q&A) period.** You are required to have your ROV with you.

**NOTE:** The product presentation is designed to be a face-to-face interaction where students and representatives from industry become engaged in conversation. MATE will not provide audio visual aids, such as slide projectors, computer projection screens, white boards, etc.; however, you are welcome to distribute handouts to help judges better understand the information that you are

presenting. **PowerPoint presentations are NOT permitted.** During the Q&A, all members of the company must be present and prepared to answer.

**Instructors, mentors, family members, friends, and members of other companies are permitted to attend.** However, we ask that those in attendance be respectful and courteous throughout the presentation and follow-up question and answer period. Be mindful that this presentation may be a stressful time for the students. If the room becomes crowded or the spectators become distracting, it is up to the judges' discretion to request that some or all spectators leave the presentation. **While they are permitted to attend, instructors and mentors are not allowed to participate.**

Each judge on the panel will award a score (50 points max). Judges' scores and comments will be returned to you shortly after the event.

Here are some examples of the questions that the judges might ask:

- How did you decide on the shape of your ROV and the materials to build it?
- How much did it cost to build your vehicle? What building materials were donated, built, or bought? What techniques did your company use to fundraise?
- Why did you decide to buy rather than build certain items – and vice versa? Can you justify your decision(s)?
- Did you reuse any components that you had built for a previous competition ROV? How did you decide which components to reuse and why?
- What design trade-offs did you make? Can you explain why?
- What type of tool(s) did you design to accomplish the product demonstration tasks and why? How does the tool(s) work?
- How many thrusters (motors) does your vehicle have? Why?
- How did you determine how much flotation to add to your vehicle?
- What is stability? Why is it important to think about stability when designing your ROV?
- If you are using the same vehicle as last year, why? What are the advantages? What, if any, modifications or additions did you make?
- Did you develop a safety checklist? What other safety precautions have you taken?

#### **Preparing for your product presentation**

- Make sure that every member of your company has a good, general working knowledge of your vehicle, even though they may have specialized in one specific aspect of its design and construction.
- Research the specifications of the components that you use in your vehicle. Be familiar with such numbers as the amount of propulsive force the thrusters produce, the weight of your ROV, etc.
- Encourage each member of your company to keep a project notebook. Before the competition, set up a time where you compare notebooks. One member might have written more

information about your ROV's electrical system, while another might have included details about buoyancy that others forgot. This exercise will help to refresh everyone's memory about the design and building process. If your company submitted technical documentation, make sure all company members have read it and are familiar with it. This exercise will help to familiarize everyone with all aspects of the project.

- Generally, you will have more to say about your ROV than can be presented in 5 or 10 minutes. That is why it is critical to organize your material and practice communicating it. However, avoid coming across as having memorized your presentation. Judges want to see that you are prepared and understand the information, not that you can simply recite a rehearsed speech from memory. Ask your instructors or mentors to give you feedback.

**NOTE:** The product presentation is designed to be a face-to-face interaction between students and industry professionals. MATE will not provide audio visual aids, such as slide projectors, computer projection screens, white boards, etc.; however, you are welcome to distribute handouts to help judges better understand the information that you are presenting.

**PowerPoint presentations are NOT permitted.** During the Q&A, all members of the company must be present and prepared to answer.

**Instructors, mentors, family members, friends, and members of other companies are permitted to attend.** However, we ask that those in attendance be respectful and courteous throughout the presentation and follow-up question and answer period. Be mindful that this presentation may be a stressful time for the students. If the room becomes crowded or the spectators become distracting, it is up to the judges' discretion to request that some or all spectators leave the presentation. **While they are permitted to attend, instructors and mentors are not allowed to participate.**

## MARKETING DISPLAY

Your company is required to create a display that will be showcased during the competition event. Your display should be an informative, clear, and concise presentation about your company and how you designed and built the specialized tools to effectively complete the product demonstrations. During the competition, your company's display will be evaluated and scored by a completely different group of working professionals – individuals who will represent science, business, government, industry, and education/outreach.

While some judges will have a technical background, others will have a communications, marketing, or public relations background. In addition, there will be visitors to the competition who may not completely understand what an ROV is or how it is used. You can think of these visitors as potential future clients who may hire you, but have a limited understanding of the technology (i.e., you need to explain your technology, the tasks, and "sell" them on YOUR products and services.) Design your display to communicate to this type of audience.

Each company will have a space approximately 3-feet x 3-feet for its display. Depending on your regional, tables may or may not be provided. Contact your [regional coordinator](#) for more information.

Each judge will award a score (50 points max). Judges' scores and comments will be returned to you shortly after the event.

## GENERAL GUIDELINES

**Note: Keep in mind that the judges may only have a short amount of time to evaluate your display. Make key points. Be concise. Keep the general public in mind. Also, make sure to label any and all figures, graphs, diagrams, and photographs.**

- **Font size that is clearly legible from a distance of 1.5 meters**
- **Choose one font style and use it throughout**
- **All measurements are in SI units (metric).** Exceptions include ½-inch PVC pipe and other items described or sold in imperial units.
- **Include headers (see REQUIRED COMPONENTS below)**
- **Photos should be clear and high-quality for the print sizes that you choose**
- **EVERY PHOTO MUST HAVE A CAPTION!** No caption = no credit for that photo. Also include photo credits if the photo was not taken by someone in your company.
- **Items that you MAY include on your marketing display:**
  - Diagrams or sketches (CAD drawings, for example). The diagrams should be clearly labeled with a brief explanation that is understandable to a general, non-technical audience. If they are overly complicated and require more technical knowledge, do not include them; technical drawings belong in the technical documentation.
- **Items that you MAY have on display include:**
  - Photo journals, pamphlets
  - Copies of your company's technical documentation
  - Resumes and business cards of the members of your company
  - Descriptions of mentoring or community outreach that your company participated in
  - Newspaper articles or other media featuring your company
- **Items that you MAY NOT include in your marketing display:**
  - Flip charts on the poster board
  - Video screens on or in the actual poster board

## REQUIRED COMPONENTS

**Note: The following are REQUIRED headers.** These headers not only assist the judges in evaluating your display, they also make your marketing display easy to read.

- **Company name and school, club, or community organization name (note that this is the only personalized header)**

Make sure that your company name is in large, bold font (larger than any other font on your marketing display). Include your school, club, or community organization name as well as your company name. Include your geographic location (i.e. city and state). If you are an international company, include the city and country.

▪ **Abstract (concise – 150 word limit)**

Include a written introduction to your company and how your company designed and built a specialized ROV and tools to complete the product demonstration tasks. Make sure to relate the product demonstration to how ROVs can be used in the real world. Don't assume that your audience knows what an ROV is or the details about the competition tasks. You can view this section as a summary of your company information, ROV design, and theme.

▪ **Company information**

Include photo(s) (group or individual) of all of the members of your company. Provide a brief description of each member. This description should include the person's name, role in the company (e.g. CEO, CFO, pilot, marketing and communications specialist, etc.) and their qualifications, such as grade level, career goals, etc.

▪ **ROV Design**

This section should be the bulk of your marketing display. It will be worth the most points.

- Why did your company build your ROV the way that you did?
- Present your ROV's "Features and Benefits." Features are the physical aspects or specifications for your vehicle, and benefits are what those features provide for the customer. For example, a feature might be a one horsepower thruster; the benefit would be the ability to make headway in a 2 knot current.
- Highlight your vehicle's safety features.
- Include photos of your ROV. Make sure to highlight the various systems of your vehicle.
- **Include photos or drawings of any special features of your vehicle and how these features relate to the product demonstration tasks, safety, general operations, etc.**  
This is the most important part of your design description.

▪ **Competition Theme**

Describe this year's competition theme and how ROVs are or could be used to support port security, health, commerce, and tourism.

Rather than repeating information that you find within the competition manual or on the Internet, take the time to think through the competition challenges and their significance in the real world. You can choose to focus on the technical, economic, or socioeconomic issue. In addition to the Internet, you are encouraged to contact individuals (such as a local scientist or industry professional) who can offer their views. You should include appropriate photos, diagrams, or sketches with captions. Be sure to appropriately cite your references / sources at the bottom of this section.

▪ **Company Evaluation/Market Assessment**

Answer the following questions:

- How would you characterize your company's overall success?



- What do you consider strengths of your company and the ROV you designed?
- What areas do you see needing improvement?
- What was the most rewarding part of this experience?
- What would you do differently next time?

■ **Acknowledgements**

Please list your sponsors (companies, organizations (including the MATE Center), professionals from industry, and/or mentors) and the type of support that they provided (funds, building supplies, equipment, site visits to facilities, time, and/or technical expertise). You can include organizations and/or individuals that provided logistical and/or moral support (e.g. your parents, siblings, or pets). Regional competition companies should also acknowledge regional contest supporters.

**Note:** “Accessories” such as video footage, PowerPoint slide presentations running on laptop computers, video projections, etc. are permitted but should be used with discretion. Remember that the judges will have a limited amount of time to evaluate your marketing display and may find excessive use of audio or video presentations distracting.

However, if you do make a video of your ROV building or competition experience, please submit information about it to the [MATE Center](#) so that it can be shared via MATE’s YouTube and Vimeo channels.

**NEW IN 2017! OUTREACH AND INSPIRATION**

The MATE Center uses underwater robotics to inspire and encourage students’ interest in STEM (science, technology, engineering, and math) education and careers. Recognizing that the students who participate in MATE competitions are powerful ambassadors for the program and MATE’s mission, the MATE Center is adding the opportunity for companies to earn up to 10 bonus points for taking part in “outreach and inspiration.”

Outreach and inspiration includes, but is not limited to, the following:

- Mentoring
- Engaging the community
- Media Outreach

Outreach and Inspiration efforts will be reviewed by competition coordinators and awarded 0 to 10 bonus points, depending on the number and scope of the outreach activity(s), i.e., the number of other students or members of the community engaged, the number of mentoring sessions, etc.

**Note:** Regionals may or may not offer Outreach and Inspiration bonus points. Contact your [regional coordinator](#) for more information.

**Mentoring** consists of, for example, providing guidance to other students in your area who are designing and building an ROV for the competition or a science or other project.

**Engaging the community** includes demonstrating your ROV and sharing information about your company at festivities and other community-wide events. Presenting to a Rotary Club or your school districts board of directors are other examples.

Please submit information about your mentoring and engaging the community efforts via the form located here – <https://www.emailmeform.com/builder/form/V90b3b7Fc6D23>, using the following naming convention: School or organization name\_company name\_Inspiration and Outreach ##\_2017, where ## is the number of the document uploaded. You can upload a variety of file types (pdfs, jpegs, etc.) and multiple files, but the size of each file should not exceed 2MB. Number each file to distinguish between them. Make sure to include the following information in your write-up:

- Type of activity (e.g. mentoring, exhibiting at a community event)
- Locations, dates, and the amount of time spent on the activity
- Number of students or community members (if a large event, this can be an approximate) involved
- Description of your actions, outcomes, and other information that helps to demonstrate the quality of your time and efforts

**Media outreach** consists of:

- Developing a list local media contacts
- Writing a press release about your participation in the MATE ROV competition
- Distributing it to your media contacts
- Following up with your media contacts to see if they're interested in your company and its ROV
- Compiling a summary of results

For the international competition, submitting your results electronically via the form located here – <https://www.emailmeform.com/builder/form/V90b3b7Fc6D23>, using the following naming convention: School or organization name\_company name\_Inspiration and Outreach ##\_2017.

Please submit a copy of your press release, a copy of your media contacts list, and a summary of news articles, TV or radio coverage, etc. that your company received. Include copies of articles and URLs, and list any television or radio coverage. Be sure to include name of outlet, date, and a summary of the coverage. You can upload a variety of file types (pdfs, jpegs, etc.) and multiple files, but the size of each file should not exceed 2MB.

### **Media Relations Guidelines**

Here are some general guidelines for working with the media. They are specific to the international competition, but can be easily modified for regional events.

1. You should begin your media effort about 4-5 weeks before the international competition (which is from June 23 – 25, 2017).

2. Write a press release highlighting your company's involvement in the upcoming MATE competition. If you participated in a regional, feel free to talk about it and how you performed. It doesn't have to be more than 1-1 ½ pages, double-spaced. Be creative.
3. Develop a list of community news media contacts, including newspapers, magazines, radio stations with public service announcements and local news, television news programs, and local online news reports or blogs. If your town is small and doesn't have any media outlets, reach out to those in the city or large town that's closest to you.
4. Try to find the name and email address of a reporter who covers education or technology—they're the ones that will be most interested in your story. You can often find this information online, or you may have to call the media outlet and speak with a receptionist to find out who the most appropriate contact is and how to reach them. Usually, email is the best way to contact a reporter.
5. Become familiar with the news outlets and the reporter that you're going to "pitch" your story to. For example, learn if they've written about your school before, or what kinds of news stories they tend to develop.
6. Compose an email introducing yourself, your company, and your school. Tell them that you're participating in the Marine Advanced Technology Education (MATE) Center's international ROV competition, which will be held in June 2017 at Long Beach City College in Long Beach, California. Explain what ROV stands for, and tell them how ROVs are used in the real world. Give examples of the skills that you and your teammates have learned by designing, building, and piloting ROVs. You may have already written some of this information for your marketing display or technical documentation.
7. Reporters are interested when a local team is participating in an international event. So make sure to let them know that the MATE competition is an international competition, funded by the National Science Foundation, the Marine Technology Society ROV Committee, and other international organizations and businesses, and that teams from all over the world participate. Be sure to provide the link to the [ROV competition web site](#).
8. Copy and paste the press release in the body of your email. (Reporters in general prefer cut and pasted releases to opening up an attachment.) If you have any photos of your company and/or ROV, especially a photo of your vehicle in action, feel free to attach the photo to the email. Explain to the reporter what's going on in each photo you attach.
9. Make sure you include your name and a phone number where the reporter can reach you. Also include MATE's contact information and let them know they can contact MATE (via Jill Zande at [jzande@marinetech.org](mailto:jzande@marinetech.org)) if they want more specific information about the program or event.
10. After you've emailed your media contacts, wait for a week and email them a reminder if you don't hear back from them.
11. If a reporter calls and wants more information, be creative about how you provide it. Offer to give interviews with a few of the company members, your mentor, or even a key sponsor. Invite them to meet you at the pool to see your ROV in action. Ask them if they want to try piloting the ROV on their own. If they want to speak with someone from MATE, give them the MATE media contact information from above.
12. If your company receives media coverage, capture the URL of the article, video or audio. If not, scan in any printed articles, or for audio/video, list the name of the media outlet, name of reporter, date

and time of broadcast and summary of the broadcast. Include these in your electronic submission.

Below is the sample press release to help you get started.

**Bridgewater High School Students to Participate in International Underwater Robotics Competition**

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**Local students develop underwater robots and learn how they help to keep our seaports safe at MATE International ROV Competition to be held at Long Beach City College**

April 15—Bridgewater, Mass.—A team from the Bridgewater High School (BHS) has been selected to compete the Marine Advanced Technology Education (MATE) Center’s 16<sup>th</sup> Annual International Student ROV Competition. Remotely operated vehicles, or ROVs, are tethered underwater robots used to complete tasks in underwater environments. The BHS team will compete against more than 60 teams from around the world, using an ROV that they designed and built during the past school year.

At the International ROV Competition, which will be held June 23 – 25 in Long Beach, California, BHS will compete against the top teams from MATE’s network of regional competitions. BHS was one of the winners in the MATE New England Regional ROV Contest, which was held last week.

Each year, MATE’s ROV competition encourages students to learn and apply science, technology, engineering, and math skills to complete tasks that simulate real-world problems from the ocean workplace. To learn entrepreneurial skills, student teams must form “companies” that produce ROV products to complete a specific set of tasks.

This year, the contest focuses on how ROVs are used to ensure the health and safety of our seaports – from monitoring cargo containers to cleaning up contaminants on the seafloor. Long Beach City College (LBCC) will host the competition events. Established in 1927, LBCC is one of California’s 113 community colleges. The college offers a variety of certificate and degree programs, including Electrical Technology, to nearly 25,000 students each semester.

Teams will participate in ROV product demonstrations that require them to pilot their vehicle to complete tasks such as constructing an underwater “hyperloop” system, sampling sediment for contaminants, investigating containers that fell from a cargo ship to the seafloor, and repairing a fountain used in a water and light show. In addition, teams must prepare technical documentation for their vehicle, make a product presentation to a panel of judges, and create a marketing display.

This is the fifth year that the BHS ROV team has participated in the New England Regional ROV Contest, and the third year it has attended the MATE International ROV Competition. The team is supported by local sponsors, including Tom’s Hobby Shop, East Bay Marina, and Schaumberg Electronics.

For more information about the BHS ROV team, please contact team marketing coordinator Jill Smith at (831) 555-1234 or [email@email.com](mailto:email@email.com).

For more information about the MATE ROV competition, visit [www.marinetech.org/rov-competition/](http://www.marinetech.org/rov-competition/) or contact Jill Zande at [jzande@marinetech.org](mailto:jzande@marinetech.org).

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